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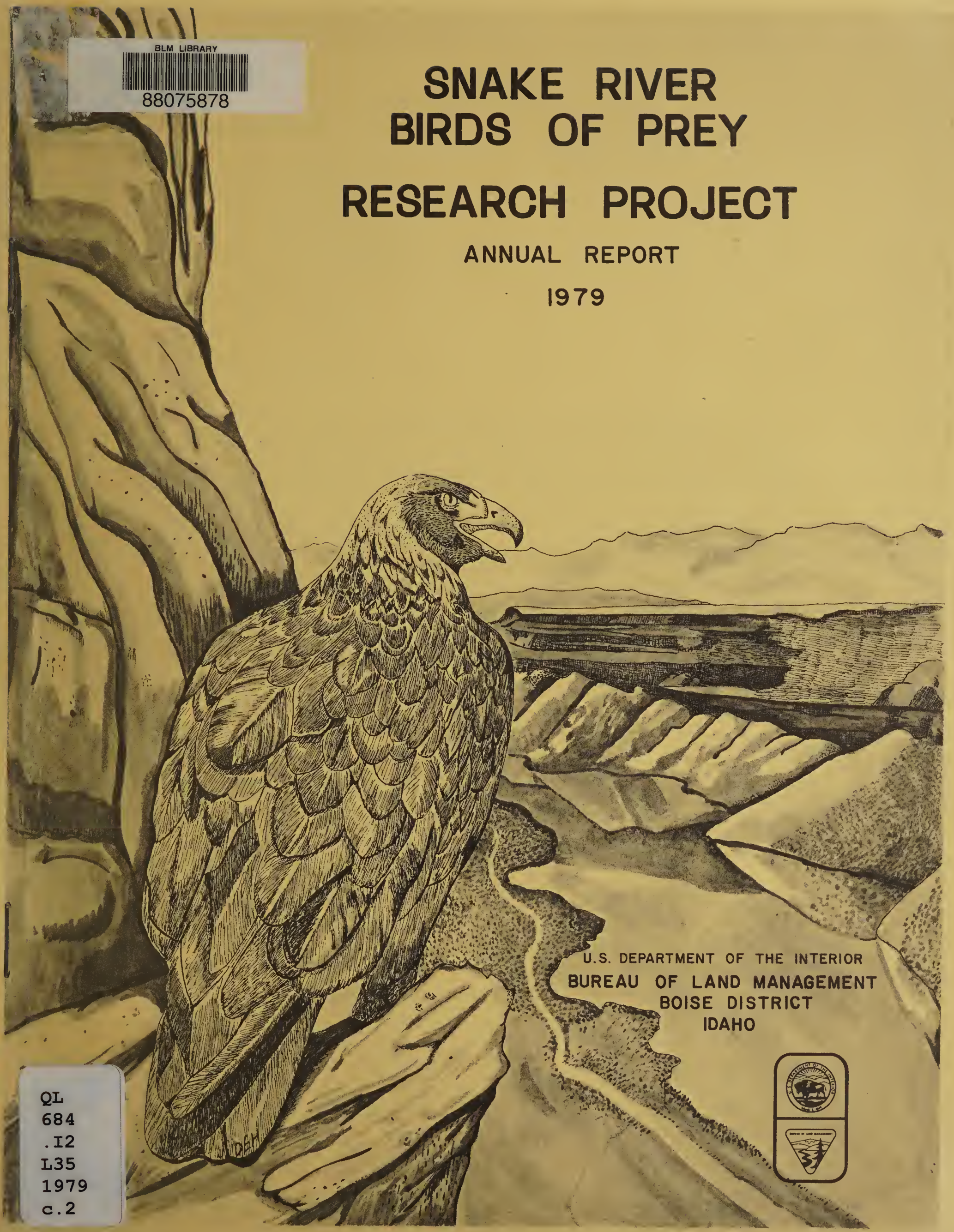

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Snake River Birds of Prey
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SNAKE RIVER BIRDS OF PREY RESEARCH PROJECT

ANNUAL REPORT

1979

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The data presented herein are preliminary and may be inconclusive. Permission to publish or cite any of these materials is therefore withheld pending specific authorization of the Boise District, BLM, and the specific Principal Investigator.

Michael N. Kochert
Project Leader

D. Dean Bibles
Boise District Manager

Robert O. Buffington
Idaho State Director

ACKNOWLEDGEMENTS

The Bureau of Land Management wishes to thank those agencies and individuals who assisted with the project. Appreciation is extended to the Idaho Fish and Game Department and the U.S. Fish and Wildlife Service for special permits and assistance. Thanks is extended to the Idaho Cooperative Wildlife Research Unit for furnishing the original background data and nest site locations; Mr. Morlan Nelson; Rick Rustan; and to those other individuals, who volunteered their services.

Special appreciation is extended to Mr. E.T. Evans for providing the area for the Melba field camp and other assistance. Sharon Stewart and Teresa Thomason deserve special thanks for typing the manuscripts.

COOPERATING AGENCIES

Idaho Fish and Game Department
U.S. Fish and Wildlife Service

PREFACE

The Snake River Birds of Prey Special Research Report to the Secretary of the Interior was the principal accomplishment of the Research Project in 1979. This report was part of a report package submitted to the Secretary that recommended protection of the unique raptor population in the Birds of Prey Area through legislative action. The Special Research Report presented data collected during Phase I of the project. It assessed the effects of additional intensive agricultural development on the stability of the raptor population and recommended a boundary for the proposed Birds of Prey National Conservation Area which was based on the spatial requirements of the raptors. The report also provided the basis for the Birds of Prey EIS which analysed the environmental and socio-economic impacts of establishing this National Conservation Area through amendment of Title VI of the Federal Land Policy and Management Act (FLPMA).

During 1978, field work was completed for all but three contract studies of the Phase I effort. Final reports were received and are on file in the Boise District office. No 1978 annual report was prepared because most contractors were preparing final reports and because of the time consuming effort required to complete the Special Research Report. Most of the data collected in 1978 were incorporated in the Special Research Report.

Research is proposed continue in the area and will study raptor-prey relationships to assess the effects of habitat alteration. In response to management needs, the Birds of Prey research staff submitted a research proposal entitled "Effects of Management Practices on Raptor-Prey-Habitat Relationships in the Snake River Birds of Prey Area" to the BLM's Resource Sciences staff in Washington, D.C. in December 1979. While Phase I defined the spatial requirements of the raptors, this Phase II research will assess raptor-prey-habitat relationships to identify the fire and grazing management practices needed to maintain the raptor populations. Phase II is expected to last 5 years. Until Phase II is approved and funded, the research will be in a transition phase.

In conjunction with meeting the June 1979 deadline for the Secretary's report, the Birds of Prey research staff also conducted the 1979 field work. This field season in which baseline prey demographic data and raptor nesting, productivity and food habits data were collected was a transition phase between the Phase I and Phase II research. In addition, field work on the last two Phase I studies (golden eagle bioenergetics and reptile ecology) was completed in 1979. This year Dr. Carl Marti from Weber State College also studied Barn Owl ecology. During the transition phase the project will gather basic biological information those raptors species which received little attention during Phase I.

This 1979 annual report presents the major results of the 1979 field season as well as the results from previous years not presented in the Special Research Report or in previous annual reports.

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INTRODUCTION

Field work for Phase I research in the Snake River Birds of Prey Study Area (BPSA) was completed in 1978. In 1979 interim research was conducted on those raptor species intensively observed from 1973 to 1978. The intention was to continue monitoring the reproductive performance and nesting population density of selected birds of prey species until decisions were made on National Conservation Area status (USDI 1979a) and future research needs for the BPSA. This report is a brief presentation of the major 1979 results as well as those results not reported in previous annual reports or in the Special Research Report (USDI 1979b).

Several portions of the Phase I research were modified or eliminated during 1979. No effort was made to determine total nesting density in the BPSA or Comparison Area. Nest site occupancy was studied within the 1977 Study Area only at sites randomly selected for intensive research. In order to reduce investigator induced mortality, no data on raptor clutch and brood sizes were specifically collected. Fall aerial transect counts of golden eagles were eliminated because results were not necessary for the current research effort.

Data were collected on several other facets of raptor ecology but are not presented in this report. Management techniques, migration, effects of researcher disturbance, raptor behavior and mortality causes are still being studied. Results will be presented when work is complete. Raptor and raven eggs collected from 1973 through 1979 were examined for fertility by R.E. Fitzner, Battelle N.W. Research Laboratories and sent for pesticide and heavy metal analysis. Results will be presented in subsequent reports.

METHODS

Study Area

Research on raptors was conducted within the 1977 BPSA (Fig. 1). The Comparison Area was searched only for golden eagles. A complete description of the BPSA and Comparison Area are given in USDI (1979b).

Nesting Density

Procedures for locating raptor and raven sites were the same as described in USDI (1979b). In May, the cliffs between Balls Point (3.2 km upstream from Swan Falls) and Chattin Hill (Grand View) were surveyed in attempt to locate all nesting raptor sites (Fig. 1). Site occupancy and reproductive performance were defined in the Birds of Prey Special Research Report (USDI 1979b).

Study Sites and Occupancy

Observations were concentrated on golden eagles, prairie falcons, red-tailed hawks, common ravens, and ferruginous hawks. Because of the large number of traditional prairie falcon, red-tailed hawk and raven

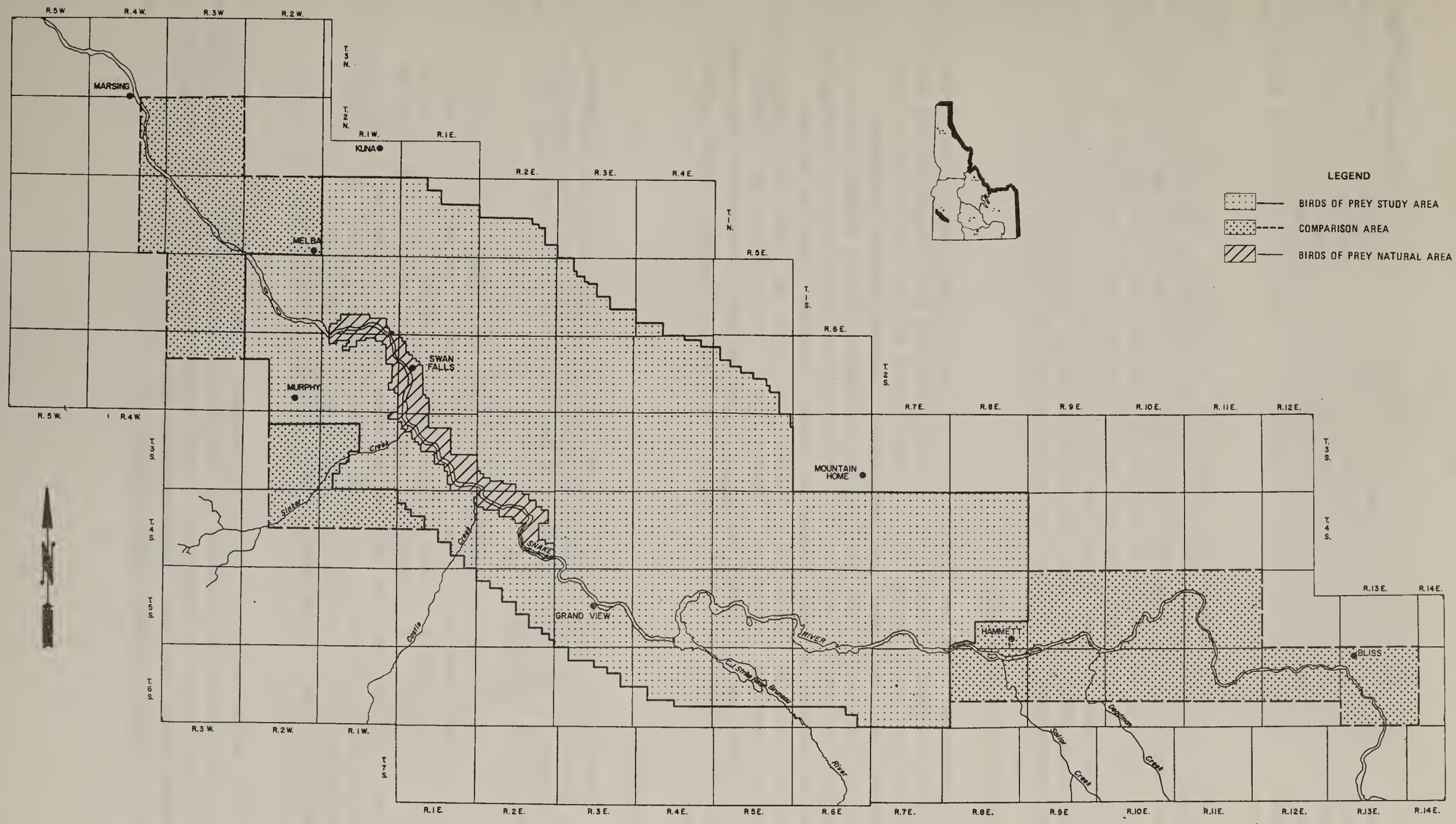

Fig. 1. LOCATION OF THE BIRDS OF PREY STUDY AREA (BPSA) AND COMPARISON AREA

pairs, it was impossible to collect information at all sites. Therefore prior to breeding season, a sample of sites, referred to as "pre-selected", was selected for intensive observation. Data on occupancy, reproductive performance, and food habits were collected from these sites. Sites were selected using stratified random sampling and proportional allocation based on densities in each 10 km stretch of the river (see USDI 1979b).

Preselected sites for 1979 were not necessarily the same as those in 1973-78. From 1978 to 1979 the number of preselected prairie falcon sites was increased from 42 to 69, red-tailed hawk sites were increased from 42 to 44, and raven sites were increased from 35 to 38. In 1978, all eagles in both the BPSA and Comparison Area were preselected, but in 1979, the preselected eagle sample included only the 36 eagle sites within the BPSA. All traditional ferruginous hawk sites in the BPSA were preselected because of the relatively small number (25).

Reproductive Performance

Procedures used to gather reproductive information were the same as in previous years (USDI 1979b). An effort was made to determine the reproductive performance at all preselected sites. Behavior of adult raptors, inaccessibility of nest sites, and logistical problems prevented collection of data on all variables at all sites. When possible, breeding attempts were confirmed by observing incubating or brooding adults without disturbing them. Because prairie falcons frequently nested in cavities, adults could not be seen incubating or brooding, and most breeding attempts had to be confirmed by climbing into the scrape and observing eggs. Results were analyzed in the same manner as reported in the Birds of Prey Special Research Report (USDI 1979b).

Food Habits

The method used to select sites for food habits studies differed from previous years. Preselected sites with nestlings were stratified by the density of the primary prey species within a generalized home range around each nest.

For golden eagles the generalized home range was a circle with the nest site as a center, a radius of 2,657 m and an area of 22.2 km^2. For red-tailed hawks it was a circle with a radius of 2,618 m and an area of 21.5 km^2. A generalized prairie falcon range was a modified elipse, with the nest at the southernmost point, a length of 16.3 km, a maximum width of 2,834 m, an area of approximately 113.3 km^2, and an orientation to the northeast (azimuth 62°). Dimensions of the generalized home ranges were based on radio-tracking results (USDI 1979b).

The amount of each cover type present in each generalized home range was calculated using programs of the Comarc Planning Information System on a Data General 330 computer. Prey densities for each home range were computed using the cover type-specific densities presented in the Special Research Report (USDI 1979b).

Golden eagle sites were stratified into high, medium and low densities of black-tailed jackrabbits (Lepus californicus). Prey remains were collected at 3 sites in each stratum. Prairie falcon and red-tailed hawk sites were stratified into high, medium and low densities of Townsend ground squirrels, and 3 sites were studied in each stratum for each raptor species.

Raven food habits were studied in 1978 and 1979 at the preselected sites by collecting prey remains at nests throughout the breeding season at irregular intervals. In 1977, raven food habits data were collected every fourth day at sites in selected land use and habitat types (Kochert et al. 1977).

Long-eared owl (Asio otus) pellets were collected below active nests and adult perches. Most collections were made after chicks had left the nests. Collection and analysis was performed by J. Marks, to be used for a proposed graduate study with the University of Montana.

Burrowing owl (Athene cunicularia) prey collections were made every fourth day in 1978 at 2 sites in the Birds of Prey Natural Area.

L. Farley, Idaho State University, analyzed prey samples. Techniques and prey weights used in the analysis were those described in USDI (1979b).

Aerial Transects

In February 1979, twenty golden eagle aerial transects were flown over the Snake River plain between Meridian and Rupert, Idaho as in previous years (Kochert et al. 1977).

Banding and Marking

Nestling raptors were ringed with U.S. Fish and Wildlife bands. Additionally, golden eagles were fitted with a yellow-blue bicolor marker on the left wing, and prairie falcons were fitted with a blue marker on the right wing (Kochert et al. 1977). All banded chicks were weighed, and their foot pads were measured (Kochert et al. 1977).

RESULTS

Nesting Density

Within the intensively searched section of the BPSA (Balls Point to Chattin Hill), the number of occupied golden eagle and red-tailed hawk sites located each year has remained stable since 1975 (Table 1). Occupied prairie falcon sites in this section decreased from a high of 62 in 1977 to 51 in 1979. Occupied raven sites steadily increased between 1975 and 1978, but decreased in 1979. Ferruginous hawks, which have always been uncommon in the area, decreased to 5 pairs within the intensively searched area in 1979, the lowest number ever observed.

Occupancy

Throughout the BPSA, the proportion of occupied traditional eagle sites decreased (Table 2). Occupancy of preselected prairie falcon sites increased from 76% in 1978 to 83% in 1979. Most (91%) preselected red-tailed hawk sites were occupied, and 5 new sites were established in 1979. The percentage of occupied ferruginous hawk and raven sites each declined to the lowest levels ever recorded during the study, 56% and 71% respectively.

Occupancy of preselected sites did not show the same trend as total nesting density within the intensively searched area. Preselected golden eagle sites shown in Table 1 were from the entire BPSA while the intensively searched area represented in Table 2 encompassed a portion of the BPSA comprised mostly of range habitat. There have been significantly more vacant eagle territories in agricultural than in range areas (USDI 1979b).

The discrepancy between percent occupancy and nesting density trends for prairie falcons and red-tailed hawks appears to be the result of pairs shifting sites between years. The total number of red-tailed hawk and prairie falcon sites identified in the BPSA exceeds the number of occupied sites for any given year which indicates a certain amount of site shifting. Because the number of traditional sites probably exceeds the potential nesting density, percent occupancy of traditional sites may not be a reliable measure of the population status for these two species.

Reproductive Performance

In 1979, 93% of preselected golden eagle pairs bred. This is a greater percentage than in any year since 1971 when 100% of the pairs laid eggs (Table 3). There was a decrease from 1978 to 1979 in the average number of chicks fledged per pair (0.94 to 0.88), per attempt (1.24 to 0.92), and per successful attempt (1.76 to 1.53). There was a general decrease in all other parameters except nestling survival and percent of pairs successful (Table 3).

From 1978 to 1979 prairie falcon reproductive performance increased in all parameters except percent breeding, which decreased from 96% to 93% (Table 4). The population is still not producing as many fledglings per breeding attempt or per pair as in the 1975-76 pre-drought years.

Most red-tailed hawk reproductive parameters increased in 1979 (Table 5). However, percent breeding decreased from 92% to 85%, and nestling survival remained relatively constant (73% vs 70%). Many of the 1979 parameters measuring productivity during incubation and early brood rearing periods (i.e. clutch size, hatchability, hatchlings per attempt, mean brood size at hatching, and nestling survival) may not be comparable to the previous year's results due to this year's small sample sizes.

Ferruginous hawk reproductive data were last presented in 1976 (Kochert et al. 1976). The 1973-79 reproductive parameters are

Table 1. Number od occupied golden eagle, prairie falcon, red-tailed hawk, ferruginous haw, and common raven sites recorded between Balls Point and Chattin Hill, 1975-79.

	1975	1976	1977	1978	1979
Golden eagle	9	9	9	9	9
Prairie falcon	58	61	62	53	51
Red-tailed hawk	22	22	23	19	21
Ferruginous hawk	7	6	7	6	5
Common raven	23	25	28	30	24
	119	123	129	117	110

Table 2. Percent of preselected traditional sites in the BPSA occupied by raptors and ravens, 1971-79. Number of traditional sites sampled in parentheses.

	Golden Eagle	Prairie Falcon	Red-tailed Hawk	Ferruginous Hawk	Common Raven
1971	100% (34)	---	---	---	---
1973	100% (34)	---	---	---	---
1974	100% (34)	---	96% (25)	83% (10)	87% (15)
1975	94% (34)	97% (29)	93% (27)	80% (10)	100% (22)
1976	97% (34)	84% (31)	83% (29)	60% (10)	92% (25)
1977	94% (34)	77% (31)	94% (31)	83% (18)	89% (28)
1978	89% (35)	76% (41)	83% (42)	72% (18)	84% (38)
1979	83% (36)	83% (69)	91% (44)	56% (38)	71% (25)

Table 3. Golden eagle reproductive parameters in the BPSA and Comparison Area, 1970-79*. (sample sizes in parentheses).

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Percent Breeding	-- --	100% (54)	-- --	56% (55)	62% (50)	78% (50)	70% (53)	84% (51)	75% (52)	93% (30)
Clutch Size	1.95 (19)	2.12 (33)	2.75 (4)	1.88 (17)	1.80 (15)	1.94 (16)	1.73 (11)	1.91 (11)	2.11 (9)	2.0 (6)
Hatchability	65% (19)	57% (30)	100% (3)	72% (15)	70% (11)	74% (16)	56% (9)	87% (8)	91% (6)	67% (6)
Hatchlings Per Attempt	1.20 (20)	1.14 (35)	2.67 (3)	1.45 (20)	1.42 (19)	1.44 (18)	1.29 (14)	1.56 (17)	1.81 (16)	1.43 (14)
Mean Brood Size at Hatching	1.67 (18)	1.74 (23)	2.67 (3)	1.71 (17)	1.69 (16)	1.73 (15)	1.64 (11)	1.80 (15)	2.07 (14)	1.87 (15)
Nestling Survival	86% (17)	83% (21)	100% (3)	59% (17)	64% (15)	61% (13)	83% (4)	45% (11)	75% (10)	82% (12)
No. Fledged Per Pair	--	1.07	--	0.43	0.56	0.65	0.63	0.96	0.94	0.88
No. Fledged Per Attempt	1.06 (18)	1.04 (49)	2.25 (4)	0.80 (30)	1.00 (28)	0.85 (34)	0.97 (29)	1.16 (31)	1.24 (29)	0.92 (26)
No. Fledged Per Successful Attempt	1.77 (26)	1.75 (32)	1.64 (22)	1.41 (17)	1.53 (19)	1.38 (21)	1.47 (19)	1.71 (21)	1.76 (21)	1.53 (19)
% of Pairs Successful	-- --	61% (51)	-- --	30% (56)	35% (54)	46% (48)	40% (50)	53% (43)	51% (47)	57% (28)
% of Attempts Successful	68% (19)	61% (51)	100% (4)	57% (30)	66% (29)	63% (35)	67% (30)	71% (35)	74% (34)	62% (26)

* Does not include data from sites where investigator manipulations (disease treatment, fostering, observation blinds, radio-tagging etc.) may have affected the parameter in question.

Table 4. Prairie falcon reproductive parameters in the BPSA, 1974-79.* Sample sizes in parentheses.

	1974	1975	1976	1977	1978	1979
Percent Breeding	94% (16)	92% (24)	96% (24)	87% (23)	96% (25)	93% (30)
% of Attempts Successful	75% (20)	87% (31)	79% (34)	69% (35)	56% (32)	82% (33)
No. Fledged Per Successful Attempt	4.00 (18)	3.83 (29)	4.02 (40)	4.00 (27)	3.52 (23)	3.69 (29)
No. Fledged Per Pair	2.65	2.83	3.05	2.40	1.58	2.45
Total Young Fledged**	----	526	631	502	289	----
Clutch Size	4.40 (10)	4.35 (17)	4.48 (25)	4.68 (28)	4.35 (34)	4.68 (31)
Hatchability	83% (9)	77% (14)	77% (21)	86% (24)	74% (22)	86% (19)
Hatchlings Per Attempt	3.50 (12)	3.61 (18)	3.33 (24)	3.74 (35)	3.11 (27)	4.73 (15)
Mean Brood Size at Hatching	4.00 (13)	3.79 (19)	3.91 (23)	4.03 (39)	3.88 (24)	4.5 (20)
Nestling Survival	80% (12)	94% (17)	84% (19)	64% (24)	67% (14)	79% (15)
No. Fledged Per Attempt	2.69 (16)	3.31 (26)	2.93 (30)	2.59 (32)	1.89 (28)	2.92 (26)
% of Pairs Successful	71% (17)	77% (26)	73% (22)	50% (18)	45% (22)	64% (42)

* Does not include data from sites where investigator manipulations (disease treatment, fostering, observation blinds, radio-tagging etc.) may have affected the parameter in question.

** Based on total number of BPSA pairs.

Table 5. Red-tailed hawk reproductive parameters in the BPSA, 1973-79.* Sample sizes in parentheses.

	1973	1974	1975	1976	1977	1978	1979
Percent Breeding	93% (14)	85% (20)	96% (24)	81% (26)	86% (29)	92% (36)	85% (40)
% of Attempts Successful	57% (14)	63% (19)	65% (23)	67% (24)	52% (29)	77% (31)	87% (30)
No. Fledged Per Successful Attempt	3.12 (8)	2.92 (13)	2.81 (16)	2.73 (15)	2.53 (17)	2.45 (22)	2.68 (31)
No. Fledged Per Pair	1.54	1.36	1.75	1.48	1.13	1.74	1.98
Total Young Fledged**	----	----	88	84	70	102	----
Clutch Size	2.00 (1)	3.00 (11)	3.25 (16)	3.06 (18)	2.95 (19)	2.71 (14)	2.75 (4)
Hatchability	50% (1)	88% (11)	84% (14)	58% (16)	61% (15)	61% (11)	73% (4)
Hatchlings Per Attempt	1.83 (6)	2.57 (14)	2.71 (17)	1.95 (19)	2.00 (21)	1.88 (16)	2.29 (7)
Mean Brood Size at Hatching	2.75 (4)	2.71 (14)	3.07 (15)	3.08 (12)	3.00 (16)	2.46 (13)	2.67 (6)
Nestling Survival	64% (4)	82% (14)	76% (15)	96% (7)	63% (9)	73% (11)	70% (4)
No. Fledged Per Attempt	1.77 (13)	1.89 (19)	1.83 (23)	1.82 (22)	1.19 (27)	1.81 (27)	2.29 (28)
% of Pairs Successful	53% (15)	48% (23)	65% (23)	59% (22)	44% (25)	70% (27)	73% (37)

* Does not include data from sites where investigator manipulations (disease treatment, fostering, observation blinds, radio-tagging etc.) may have affected the parameter in question.

** Based on total number of BPSA pairs.

presented in Table 6. The small sample sizes make comparison between years difficult. However, 1977 appears to have been the poorest year for ferruginous hawk reproduction while 1976 was the best.

Raven reproduction results were last presented in 1977 (Kochert et al. 1977). Reproductive performance was the lowest in 1978 when only 65% of the breeding attempts fledged chicks, and an average of 1.88 young fledged per pair (Table 7). Although the percent of breeding pairs decreased from 87% in 1978 to 81% in 1979, success as measured by numbers of chicks fledged per pair and per attempt increased from 1.88 to 2.31 and 3.43 to 3.95 respectively.

Food Habits

Golden eagle food habits for 1979 are presented in Table 8. Black-tailed jackrabbits comprised 52% of the individuals and 79% of the prey biomass. Ring-necked pheasants (Phasianus colchicus) and mountain cottontails (Sylvilagus nuttallii) were the major alternate prey. No other species comprised more than 5% of the individuals consumed or more than 3% of the biomass.

Townsend ground squirrels comprised most of the prairie falcon prey in 1979, with 43% of the individuals and 59% of the biomass (Table 9). No other single species ranked as an important secondary prey in the diet, although lagomorphs totaled 15% of the biomass.

Red-tailed hawks preyed on at least 41 species of mammals, birds, reptiles and amphibians, but black-tailed jackrabbits and mountain cottontails comprised 55% of the prey biomass (Table 10). The only other species comprising more than 10% of the prey biomass was the Townsend ground squirrel.

Food habits of ravens were last reported for 1976 (Kochert et al. 1976). In 1977, 1978 and 1979 Townsend ground squirrels, black-tailed jackrabbits, mountain cottontails and unidentified rabbits each comprised over 10% of the prey biomass (Tables 11, 12, 13). Townsend ground squirrels, which were the major prey in 1977, declined from 36% of the prey biomass in 1977 to 15% in 1979. Lagomorphs comprised over 30% of the prey biomass in all 3 years and were the major prey in 1978 and 1979.

Long-eared owls fed almost entirely on small mammals (98% of biomass). Voles (Microtus spp.), deer mice (Peromyscus maniculatus) and Ord kangaroo rats (Dipodomys ordii) combined totaled 86% of the prey biomass consumed (Table 14).

The 1978 burrowing owl prey remains were comprised of mammals, birds, lizards and invertebrates. Kangaroo rats were the only prey species comprising more than 10% of the biomass (Table 15).

Golden Eagle Populations

Results of the 1972-79 golden eagle aerial transects are presented in Table 16. Mid-winter eagle numbers have remained almost constant

Table 6. Ferruginous hawk reproductive parameters in the BPSA, 1973-79. Sample sizes in parentheses.

	1973	1974	1975	1976	1977	1978	1979
Percent Breeding	----	60%	83%	83%	100%	77%	60%
	----	(5)	(6)	(6)	(12)	(13)	(15)
% of Attempts Successful	0%	33%	----	83%	31%	58%	67%
	(3)	(3)	----	(6)	(13)	(12)	(9)
No. Fledged Per Successful Attempt	----	2.00	3.00	3.56	1.50	3.17	3.0
	----	(1)	(2)	(9)	(2)	(6)	(10)
No. Fledged Per Pair	----	----	----	2.45	0.43	1.42	1.21
Clutch Size	3.67	----	----	4.00	3.86	3.60	1.5
	(3)	----	----	(3)	(7)	(5)	(2)
Hatchability	64%	----	----	83%	44%	100%	67%
	(11)	----	----	(12)	(16)	(15)	(2)
Hatchlings Per Attempt	2.33	0	1.00	3.40	2.00	3.60	2.25
	(3)	(1)	(2)	(5)	(5)	(5)	(4)
Mean Brood Size at Hatching	3.50	----	2.00	3.40	2.50	3.60	3.0
	(2)	----	(1)	(5)	(4)	(5)	(3)
Nestling Survival	0	----	100%	86%	30%	56%	89%
	(7)		(2)	(14)	(10)	(18)	(2)
No. Fledged Per Attempt	0	0	1.50	2.83	.27	1.73	1.89
	(3)	(2)	(4)	(6)	(11)	(11)	(9)
% of Pairs Successful	----	20%	33%	67%	25%	38%	40%
	----	(5)	(6)	(6)	(12)	(13)	(15)

from February 1977 to January 1979 but the proportion of immature birds increased from 6% to 22%.

Banding and Marking

During 1979, 24 golden eagles, 74 prairie falcons, 36 red-tailed hawks, 30 ferruginous hawks, 47 ravens, and 54 fledglings of other raptor species were banded. Fourteen golden eagles and 55 prairie falcons were wing-marked.

Table 7. Common raven reproductive parameters in the BPSA, 1973-79.* Sample sizes in parentheses.

	1973	1974	1975	1976	1977	1978	1979
Percent Breeding	---- ----	100% (12)	90% (20)	89% (19)	95% (22)	87% (31)	81% (26)
% of Attempts Successful	67% (3)	61% (18)	68% (25)	76% (25)	68% (37)	65% (31)	75% (20)
No. Fledged Per Successful Attempt	4.45 (11)	4.17 (12)	3.91 (23)	4.09 (22)	3.81 (21)	3.43 (21)	3.95 (21)
No. Fledged Per Pair	----	2.35	2.18	2.48	2.15	1.88	2.31
Total Young Fledged**	----	----	237	315	295	248	----
Clutch Size	5.33 (3)	5.70 (10)	5.15 (13)	5.56 (9)	5.27 (22)	4.94 (16)	4.71 (7)
Hatchability	45% (2)	54% (6)	77% (6)	53% (3)	43% (8)	88% (3)	50% (4)
Hatchlings Per Attempt	2.50 (2)	3.00 (7)	3.63 (8)	4.50 (8)	2.67 (12)	5.20 (5)	1.67 (3)
Mean Brood Size at Hatching	5.33 (16)	3.63 (29)	4.38 (35)	5.00 (40)	4.57 (32)	5.20 (26)	5.0 (2)
Nestling Survival	90% (2)	40% (7)	69% (6)	86% (6)	64% (5)	81% (3)	90% (2)
No. Fledged Per Attempt	2.67 (8)	2.38 (38)	2.19 (46)	2.84 (54)	2.21 (62)	1.78 (41)	3.0 (18)
% of Pairs Successful	---- ----	58% (12)	65% (23)	67% (21)	58% (19)	52% (27)	59% (27)

* Does not include data from sites where investigator manipulations (disease treatment, fostering, observation blinds, radio-tagging etc.) may have affected the parameter in question.

** Based on total number of BPSA pairs.

Table 8. Prey items found at systematically sampled golden eagle nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
MAMMALS				
Black-tailed Jackrabbit	331	52.4	556,932	79.1
Mountain Cottontail	126	19.9	58,379	8.3
Yellow-bellied Marmot	26	4.1	20,316	2.9
Townsend Ground Squirrel	17	2.7	3,047	0.4
Kangaroo Rat, Unid.	7	1.1	371	0.1
Bushy-tailed Woodrat	6	0.9	1,705	0.2
Vole	3	0.5	90	0.0
Desert Woodrat	2	0.3	225	0.0
Woodrat, Unid.	1	0.2	230	0.0
White-tailed Antelope Squirrel	1	0.2	106	0.0
Rodent, Unid.	1	0.2	50	0.0
Townsend Pocket Gopher	1	0.2	240	0.0
Deer Mouse	1	0.2	19	0.0
Coyote	1	0.2	2,043	0.3
Pocket Gopher, Unid.	1	0.2	200	0.0
Pygmy Rabbit	1	0.2	340	0.0
SUBTOTAL	526	82.3	644,243	91.3
BIRDS				
Ring-necked Pheasant	31	4.9	34,579	4.9
Rock Dove	12	1.9	3,984	0.6
Chukar	5	0.8	3,010	0.4
Raven	5	0.8	4,435	0.6
Gray Partridge	4	0.6	1,556	0.2
Kestrel	2	0.3	228	0.0
Barn Owl	2	0.3	1,206	0.2
California Quail	2	0.3	340	0.0
Short-eared Owl	1	0.2	348	0.0
Passerine, Unid.	1	0.2	56	0.0
Western Meadowlark	1	0.2	96	0.0
Galliformes, Unid.	1	0.2	575	0.1
Black-billed Magpie	1	0.2	170	0.0
Burrowing Owl	1	0.2	170	0.0
SUBTOTAL	69	11.1	50,753	7.0
REPTILES				
Gopher Snake	27	4.3	5,817	0.8
Horned Lizard	1	0.2	18	0.0
Western Fence Lizard	1	0.2	17	0.0
Racer	1	0.2	77	0.0
Whiptail Lizard	1	0.2	8	0.0
Striped Whipsnake	1	0.2	109	0.0
SUBTOTAL	32	5.3	6,046	0.8

Table 8 (cont). Prey items found at systematically sampled golden eagle nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
FISH				
Carp	5	0.8	2,915	0.4
TOTAL	632	99.5	704,007	99.5

Table 9. Prey items found at systematically sampled prairie falcon nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
MAMMALS				
Townsend Ground Squirrel	152	42.7	27,676	58.6
Vole	31	8.7	930	2.0
Deer Mouse	14	3.9	257	0.5
Mouse, Unid.	12	3.4	300	0.6
Kangaroo Rat, Unid.	12	3.4	636	1.3
Mountain Cottontail	7	2.0	2,986	6.3
Bushy-tailed Woodrat	5	1.4	1,395	3.0
Antelope Ground Squirrel	4	1.1	424	0.9
Townsend Pocket Gopher	4	1.1	960	2.0
Shrew, Unid.	3	0.8	40	0.1
Black-tailed Jackrabbit	3	0.8	2,321	4.9
Rabbit, Unid.	2	0.6	1,894	4.0
Woodrat, Unid.	2	0.6	460	1.0
Desert Woodrat	2	0.6	225	0.5
Pocket Gopher, Unid.	2	0.6	400	0.8
Least Chipmunk	1	0.3	32	0.1
Great Basin Pocket Mouse	1	0.3	15	0.0
SUBTOTAL	257	72.3	40,951	86.6
BIRDS				
Horned Lark	31	8.7	806	1.7
Passerine, Unid.	10	2.8	560	1.2
Rock Dove	3	0.8	996	2.1
Western Meadowlark	13	3.7	1,248	2.6
Black-billed Magpie	2	0.6	340	0.7
Says Phoebe	2	0.6	56	0.1
Red-winged Blackbird	2	0.6	96	0.2
Chukar	2	0.6	600	1.3
Lark Sparrow	2	0.6	56	0.1
Bird, Unid.	2	0.6	650	1.4
Rail, Unid.	1	0.3	70	0.1
Burrowing Owl	1	0.3	170	0.4
Brewer's Blackbird	1	0.3	68	0.1
Gray Partridge	1	0.3	30	0.1
Yellow-headed Blackbird	1	0.3	91	0.2
Brown-headed Cowbird	1	0.3	41	0.1
Canyon Wren	1	0.3	10	0.0
Rock Wren	1	0.3	17	0.0
SUBTOTAL	77	22.0	5,905	12.4

Table 9 (cont). Prey items found at systematically sampled prairie falcon nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
REPTILES				
Horned Lizard	12	3.4	230	0.5
Whiptail Lizard	7	2.0	98	0.2
Snake, Unid.	1	0.3	19	0.0
Western Fence Lizard	1	0.3	17	0.0
SUBTOTAL	21	6.0	364	0.7
INVERTEBRATES				
Locustidae	1	0.3	1	0.0
TOTAL	356	100.6	47,221	99.7

Table 10. Prey items found at systematically sampled red-tailed hawk nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
MAMMALS				
Townsend Ground Squirrel	92	20.5	16,292	14.1
Mountain Cottontail	78	17.4	25,860	22.4
Kangaroo Rat, Unid.	39	8.7	2,067	1.8
Black-tailed Jackrabbit	33	7.4	37,467	32.5
Vole	21	4.7	624	0.5
Deer Mouse	8	1.8	116	0.1
Desert Woodrat	8	1.8	1,125	1.0
Yellow-bellied Marmot	7	1.6	10,391	9.0
Townsend Pocket Gopher	6	1.3	680	0.6
Bushy-tailed Woodrat	4	0.9	930	0.8
Mouse, Unid.	3	0.7	75	0.1
Woodrat, Unid.	2	0.4	460	0.4
Rabbit, Unid.	1	0.2	343	0.3
Pygmy Rabbit	1	0.2	340	0.3
Pocket Gopher, Unid.	1	0.2	200	0.2
SUBTOTAL	304	67.8	96,970	84.1
BIRDS				
Passerine, Unid.	9	2.0	504	0.4
Red-winged Blackbird	3	0.7	144	0.1
Horned Lark	2	0.4	52	0.0
Rock Dove	2	0.4	664	0.6
Chukar	2	0.4	600	0.5
Rock Wren	2	0.4	34	0.0
Sage Sparrow	1	0.2	24	0.0
Western Meadowlark	1	0.2	96	0.1
California Quail	1	0.2	170	0.1
Ring-necked Pheasant	1	0.2	600	0.5
Black-billed Magpie	1	0.2	170	0.1
Rail, Unid.	1	0.2	70	0.1
Starling	1	0.2	79	0.1
Mallard	1	0.2	1,248	1.1
Yellow-breasted Chat	1	0.2	26	0.0
Yellow-headed Blackbird	1	0.2	74	0.1
SUBTOTAL	30	6.3	4,555	3.8
REPTILES				
Gopher Snake	54	12.1	10,596	9.2
Whiptail Lizard	24	5.4	363	0.3
Striped Whipsnake	11	2.5	1,140	1.0
Horned Lizard	9	2.0	168	0.1
Ground Snake	7	1.6	56	0.0
Racer	3	0.7	231	0.2

Table 10 (cont). Prey items found at systematically sampled red-tailed hawk nest sites, 1979

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
REPTILES (cont.)				
Western Rattlesnake	2	0.4	800	0.7
Western Fence Lizard	1	0.2	17	0.0
Garter Snake	1	0.2	500	0.4
Leopard Lizard	1	0.2	26	0.0
SUBTOTAL	113	25.3	13,897	11.9
AMPHIBIANS				
Woodhouse Toad	1	0.2	20	0.0
TOTAL	448	99.6	115,442	99.8

Table 11. Prey items found at systematically sampled raven nest sites, 1977.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent of Biomass
MAMMALS				
Townsend Ground Squirrel	42	7.5	8,711	35.6
Deer Mouse	20	3.6	353	1.4
Harvest Mouse	8	1.4	88	0.4
Kangaroo Rat, Unid.	7	1.2	371	1.5
Vole	4	0.7	120	0.5
Great Basin Pocket Mouse	3	0.5	45	0.2
Black-tailed Jackrabbit	3	0.5	6,330	25.9
Pocket Gopher, Unid.	3	0.5	500	2.0
Mountain Cottontail	2	0.4	1,300	5.3
Mouse, Unid.	1	0.2	25	0.1
Desert Woodrat	1	0.2	150	0.6
Woodrat, Unid.	1	0.2	230	0.9
Ground Squirrel, Unid.	1	0.2	172	0.7
SUBTOTAL	96	17.1	18,395	75.1
BIRDS				
Domestic Chicken	1	0.2	3,120	12.8
Lark Sparrow	1	0.2	28	0.1
Passerine, Unid.	1	0.2	56	0.2
SUBTOTAL	3	0.6	3,204	13.1
REPTILES				
Gopher Snake	1	0.2	232	0.9
Whiptail Lizard	1	0.2	17	0.1
SUBTOTAL	2	0.4	249	1.0
FISH				
Bass	3	0.5	1,100	4.5
Fish, Unid.	2	0.4	120	0.5
Squawfish	2	0.4	170	0.7
Centrarchid Fish	1	0.2	60	0.2
Carp	1	0.2	583	2.4
Chiselmouth	1	0.2	80	0.3
SUBTOTAL	10	1.9	2,113	8.6
INVERTEBRATES				
Scarabidae	247	43.9	247	1.0
Scorpionidae	21	3.7	21	0.1
Locustidae	5	0.9	5	0.0
Gryllacridae	2	0.4	4	0.0
SUBTOTAL	275	49.0	277	1.1

Table 11 (cont). Prey items found at systematically sampled raven nest sites, 1977.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
MISCELLANEOUS				
Corn (Kernels)	175	31.1	175	0.7
Bird Eggs	1	0.2	20	0.1
Crayfish	1	0.2	3	0.0
SUBTOTAL	177	31.5	198	0.8
TOTAL	563	100.5	24,436	99.7

Table 12. Prey items found at irregularly sampled raven nest sites, 1978.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent of Biomass
MAMMALS				
Townsend Ground Squirrel	58	12.1	10,919	22.1
Kangaroo Rat, Unid.	37	7.7	1,961	4.0
Vole	29	6.1	864	1.7
Pocket Gopher, Unid.	25	5.2	3,500	7.1
Deer Mouse	17	3.6	305	0.6
Mouse, Unid.	10	2.1	250	0.5
Black-tailed Jackrabbit	9	1.9	13,874	28.1
Mountain Cottontail	8	1.7	1,145	2.3
Geat Basin Pocket Mouse	4	0.8	50	0.1
Bushy-tailed Woodrat	2	0.4	620	1.3
Rabbit, Unid.	2	0.4	1,047	2.1
Harvest Mouse	2	0.4	22	0.0
Ord Kangaroo Rat	2	0.2	53	0.1
Long-tailed Weasel	1	0.2	178	0.4
Rodent, Unid.	1	0.2	50	0.1
SUBTOTAL	206	43.0	34,838	70.5
BIRDS				
Passerine, Unid.	11	2.3	616	1.2
Western Meadowlark	3	0.6	288	0.6
Ring-necked Pheasant	2	0.4	1,810	3.7
Avian, Unidentified	2	0.4	250	0.5
Kestrel	1	0.2	114	0.2
Chukar	1	0.2	602	1.2
Red-tailed Hawk	1	0.2	800	1.6
SUBTOTAL	21	4.3	4,480	9.6
REPTILES				
Horned Lizard	6	1.3	108	0.2
Gopher Snake	5	0.8	865	1.8
Striped Whipsnake	3	0.6	327	0.7
Lizard, Unid.	3	0.6	48	0.1
Whiptail Lizard	3	0.6	45	0.1
Snake, Unid.	3	0.6	621	1.3
Side-blotched Lizard	1	0.2	4	0.0
SUBTOTAL	23	4.7	2,018	5.0
AMPHIBIANS				
Spadefoot Toad	7	1.5	84	0.2
Woodhouse Toad	2	0.4	40	0.1
SUBTOTAL	9	1.9	124	0.3

Table 12 (cont). Prey items found at irregularly sampled raven nest sites, 1978.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent of Biomass
FISH				
Fish, Unid	7	1.5	4,081	8.3
Carp	4	0.8	2,332	4.7
Sucker	4	0.8	430	0.4
Centrarchid Fish	2	0.4	160	0.3
Bass	1	0.2	500	1.0
Squawfish	1	0.2	90	0.2
SUBTOTAL	19	3.9	7,593	15.4
INVERTEBRATES				
Scarabidae	154	32.2	154	0.3
Scorpionidae	17	3.6	17	0.0
Insects, Unid.	5	1.0	5	0.0
Locustidae	1	0.2	1	0.0
SUBTOTAL	177	37.0	177	0.3
MISCELLANEOUS				
Corn (Kernels)	15	3.1	15	0.0
Bird Eggs	8	1.7	160	0.3
SUBTOTAL	23	4.8	175	0.3
TOTAL	478	99.6	49,405	100.6

Table 13. Prey items found at irregularly sampled raven nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent of Biomass
MAMMALS				
Vole	49	6.4	1,442	3.1
Townsend Ground Squirrel	39	5.1	7,261	15.4
Kangaroo Rat, Unid.	26	3.4	1,378	2.9
Deer Mouse	21	2.7	363	0.8
Mountain Cottontail	15	2.0	5,127	10.9
Desert Woodrat	10	1.3	1,200	2.6
Rabbit, Unid.	7	0.9	6,025	12.8
Black-tailed Jackrabbit	6	0.8	7,367	15.7
Mouse, Unid.	6	0.8	150	0.3
Townsend Pocket Gopher	6	0.8	1,060	2.3
Rodent, Unid.	3	0.4	150	0.3
Bushy-tailed Woodrat	3	0.4	775	1.6
Yuma Myotis	2	0.3	12	0.0
House Mouse	2	0.3	22	0.0
SUBTOTAL	195	25.6	32,332	68.7
BIRDS				
Passerine, Unid.	7	0.9	392	0.8
AMPHIBIANS AND REPTILES				
Horned Lizard	10	1.3	171	0.4
Gopher Snake	6	0.8	1,266	2.7
Snake, Unid.	3	0.4	621	1.3
Striped Whipsnake	2	0.3	218	0.5
Woodhouse Toad	2	0.3	40	0.1
Whiptail Lizard	1	0.1	15	0.0
Lizard, Unid.	1	0.1	16	0.0
SUBTOTAL	25	3.3	2,347	5.0
FISH				
Fish, Unid.	7	0.9	3,558	7.6
Carp	5	0.7	2,915	6.2
Sucker	1	0.1	100	0.3
Black Crappie	1	0.1	2,000	4.3
SUBTOTAL	14	1.8	8,573	18.3

Table 13 (cont). Prey items found at irregularly sampled raven nest sites, 1979.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent of Biomass
INVERTEBRATES				
Scorpionidae	20	2.6	20	0.0
Locustidae	16	2.1	16	0.0
Gryllacridae	5	0.7	10	0.0
Scarabidae	101	13.2	101	0.2
SUBTOTAL	142	18.6	147	0.2
MISCELLANEOUS				
Vegetation, Misc.	305	39.9	3,050	6.5
Corn (Kernels)	70	9.2	70	0.1
Bird Eggs	6	0.8	120	0.3
SUBTOTAL	381	49.9	3,240	6.9
TOTAL	764	100.1	47,031	99.9

Table 14. Prey items found at long-eared owl nest sites, 1979*

Species	Number of Individuals	Percent of Individuals	Biomass (g)	Percent of Biomass
Mammals				
Vole	91	26.3	2,730	27.0
Deer Mouse	90	26.0	1,710	16.9
Ord Kangaroo Rat	80	23.1	4,240	41.9
Harvest Mouse	36	10.4	396	3.9
Great Basin Pocket Mouse	31	9.0	465	4.6
House Mouse	13	3.8	221	2.2
Mountain Cottontail	2	0.6	200	2.0
SUBTOTAL	343	99.2	9,962	98.5
Birds				
Passerine, Unid.	3	0.9	168	1.7
TOTAL	346	100.1	10,130	100.2

* Collection and analysis performed by J. Marks, University of Montana.

Table 15. Prey items found at systematically sampled burrowing owl nest sites, 1978.

Species	No. of Individuals	Percent of Individuals	Biomass (g)	Percent Biomass
MAMMALS				
Kangaroo Rat, Unid.	50	12.1	2,650	62.2
Mouse, Unid.	9	2.2	235	5.3
Deer Mouse	7	1.7	133	3.1
Rabbit, Unid.	2	0.5	200	4.7
SUBTOTAL	68	16.5	3,208	75.3
BIRDS				
Horned Lark	7	1.7	182	4.3
Passerine, Unid.	6	1.4	336	7.9
Lark Sparrow	2	0.5	56	1.3
Mourning Dove	1	0.2	134	3.1
SUBTOTAL	16	3.8	708	16.6
REPTILES				
Lizard, Unid.	1	0.2	16	0.4
INVERTEBRATES				
Scarabidae	253	61.1	253	5.9
Scorpionidae	58	14.0	58	1.4
Hymenoptera	18	4.3	18	0.4
SUBTOTAL	329	79.4	329	7.7
TOTAL	414	99.9	4,261	100.0

Table 16. Results of aerial transect sampling on 17,920 km^2 (7000 mi^2) of the Snake River floodplain, 1972-79.

	Golden Eagles					
Date	No. Adults	No. Immatures	No. Unknown	Total	Percent Immature	Eagles/100 mi^2 /(100 km^2)
Oct 72	10	11	8	29	52%	5.8(2.2)
Feb 73	33	33	18	84	50%	16.8(6.4)
Oct 73	7	3	7	17	30%	3.4(1.3)
Jan 74	20	9	12	41	31%	8.2(3.2)
Oct 74	4	2	10	16	33%	3.2(1.2)
Feb 75	17	8	7	32	32%	6.4(2.5)
Oct 75	10	0	5	15	00%	3.0(1.2)
Jan 76	24	9	6	41	27%	8.2(3.2)
Oct 76	4	0	3	7	00%	1.4(0.5)
Feb 77	16	1	9	26	06%	5.2(2.0)
Oct 77	5	0	6	11	00%	2.2(0.8)
Jan 78	16	3	10	29	16%	5.8(2.2)
Oct 78	8	2	6	16	20%	3.2(1.2)
Jan 79	14	4	9	27	22%	5.4(2.1)

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TITLE: Ecology of Nesting Barn Owls in the Snake River Birds of Prey Area

INVESTIGATOR: Carl D. Marti, Department of Zoology, Weber State University, Ogden, Utah 84408.[1]

PROJECT SUPPORT: U.S. Department of the Interior, Bureau of Land Management, Purchase Order No. ID-010-PH9-0155.

OBJECTIVES:

1. Determine barn owl food habits and daily activity patterns.
2. Record reproductive performance and nest site use of barn owls.

INTRODUCTION

This paper reports a study of barn owl (Tyto alba) ecology in the Snake River Birds of Prey Study Area (BPSA) during the breeding season of 1979. Emphasis was on foods eaten and daily activity patterns. Observations were also made on reproductive performance. Even though the barn owl is common in the BPSA, it has been the subject of only cursory study prior to this investigation.

I am grateful to the following personnel of the U.S. Bureau of Land Management for their help in logistics and in the field: M. Kochert, A. Bammann, K. Steenhof, J. Marks, J. Doremus and L. Chittenden. The BLM provided a vehicle for use in the field and lodging at a field camp. I would also like to thank D. Johnson for identification of shrew remains.

METHODS

Research was done within the 338,778 ha BPSA along the Snake River in Canyon, Ada and Elmore Counties, Idaho. Studies were concentrated in an area near Melba on the west edge of the BPSA and in one near Grandview at the center of the BPSA.

Barn owl nests were located from BLM nest records and by walking along the base of cliff lines to look for accumulations of old pellets. At selected sites, pellets were collected on a regular basis and analyzed by standard techniques to provide food habits information. Diets were further analyzed for diversity by Shannon's information function:

$$H = -\sum_{i=i}^{s} P_i \log_2 P_i$$

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[1] Dr. Marti performed this work while on sabbatical leave from Weber State College.

where s is the total number of species in the sample and P_i is the number of individuals belonging to the ith species. Chi-square analysis was used to test similarities among samples.

Daily activity was studied by direct observation and by the use of an automatic activity recorder. A blind was erected near 1 nest and 3 other nests were observed from a vehicle. Small battery powered bulbs were installed at 2 nests to permit better observation.

Reproductive data were recorded when it was possible to gain access to nest sites.

RESULTS

Food Habits

Forty-three collections of pellets were made at 15 sites yielding a total of 7,264 prey individuals (Table 1). Prey diversity for all collections combined was 2.48. Diversity for individual collection sites ranged from 1.47 to 2.73. These fall within the range of other studies of barn owl diets from the United States and northern Europe (Smith and Marti 1976) but are higher than most from southern Europe (Herrera 1974).

Montane voles (Microtus montanus) were the most important food species, being more than twice as abundant as the next most common prey. They also provided about twice as much biomass as the next prey (Table 1). Little information is available on the abundance and distribution of voles in the BPSA. Wolfe and Montan (1976) reported that voles were caught there only in very wet areas. However, they estimated the density may reach 750 to 1500 individuals per ha in favorable areas. The larger numbers taken by barn owls indicate that voles are locally abundant. Four prey, montane vole, Ord's kangaroo rat (Dipodomys ordii), deer mouse (Peromyscus maniculatus) and house mouse (Mus musculus), made up 85% of all food of barn owls by number and 76% by weight. Montan (1977) associated 3 of these species with agricultural land. The fourth, the deer mouse, was the most widely distributed and most common small mammal in the BPSA. Pocket gophers (Thomomys spp.) contributed 12% of the diet by weight but only 3.6% by number. Gophers are preyed upon heavily by barn owls in some areas (Fitch 1947, Marti 1976) but in the BPSA they occur only in scattered localities where soils are suitable for tunneling (Wolfe and Oftedahl 1977).

Only 3 individuals of 2 diurnal mammal species were found as barn owl prey: 1 antelope ground squirrel (Ammospermophilus leucurus) and 2 Townsend ground squirrels (Spermophilus townsendi).

Birds were unimportant as prey, making up only 1.5% of the total diet by number.

Estimated mean individual prey weight was 32 g and only 11% of all prey was estimated to weight over 100 g each. The 32 shrews (Sorex vagrans) found, although unimportant as barn owl prey, are of interest

because only a single shrew had been previously identified as prey in all the raptor diets from the BPSA (U.S.D.I. 1979).

At several nests, collections were made of pellets which appeared, by the degree of weathering and decomposition, to be from the 1978 nesting season. Prey in these were compared to prey form the 1979 nesting season. No significant difference was found at 2 sites in Canyon County (Jensen Cliff, $\chi^2 = 4.14$, $0.5 < P < 0.1$ and Mary's, $\chi^2 = 7.42$, $0.5 < P < 0.1$). However, at 2 sites in Elmore County, significant difference appeared between the years (Road End, $\chi^2 = 63.01$, $P < 0.005$, and Upper Lower Black Butte, $\chi^2 = 277.92$, $P < 0.005$). A significant difference was also found between prey from all sites in 1978 and 1979 ($\chi^2 = 77.38$, $P < 0.005$).

Even though montane voles were the most common prey found in the majority of collection nests, a considerable amount of difference was found in the array of prey taken at different sites. When all prey were combined from nests in agricultural areas near Melba and compared with combined prey from agricultural areas near Grandview, a significant difference was found ($\chi^2 = 318.36$, $P < 0.005$). Voles were by far the most abundant prey in both areas (50.1% and 63.6%) but the order of less abundant prey varied considerably.

A significant difference also occurred among 3 sites near Melba (Mary's, Kitten's and Jensen Cliff, $\chi^2 = 32.58$, $P < 0.005$). The order of abundance of the 3 most common prey was the same for each site but percentages of these and the order of other prey caused the differences to be significant.

Diets from 3 very similar sites in Elmore County (Garbage Draw, Road End and Fence Corner) were also significantly different ($\chi^2 = 145.85$, $P < 0.005$).

Activity Patterns

Data on daily activity (time activity began and ended and visits to the nest to feed young) were obtained on 47 nights between 26 March and 22 June. Data on twenty-nine nights were obtained from an automatic recorder at 1 nest (Mary's). The remainder came from direct observation from a blind and a vehicle. Additionally, 1 site (Mary's) was monitored by both the activity recorder and observation for several nights. First activity in the evening averaged 35.5 min after sunset and mean time of last activity was 40.0 min before sunrise. First foraging, although difficult to quantify, was usually 30-45 minutes after the owls left their roosts, the interval being occupied with preening, stretching, and short flights around the roost and nest. I found that nesting barn owls in Colorado began activity an average of 90 min after sunset (Marti 1976). In rare instances barn owls have been seen hunting even in daylight (Harte 1954, Haverschmidt 1970) probably because prey was very scarce. At Mary's site, adults averaged 15.3 visits per night to the nest between 17 May and 15 June. There were 4 young in the nest. Observations from a blind at that site indicated each visit was a food delivery. However, most of the data on number of nest visits were from the activity recorder, and it cannot be confirmed that food was brought at each visit.

Nest Sites

In the BPSA, most barn owls chose cavities in rock cliffs for nesting. These cavities ranged in height above the cliff base from 2.5 to 21 m, but most are less than 6 m high. The majority of cavities used were deep (at least 1 m). Many of these nest sites showed evidence of long and probably continual occupancy. Some barn owl pairs selected cavities in banks of washes, gravel pits or similar sites. Two pairs were discovered in 1979 nesting in stacks of baled hay.

Reproduction

Reproductive data were obtained on 9 sites. Eight of these were single nests, and the ninth (Upper Lower Black Butte) was a colony containing 4-6 nesting pairs. Complete reproductive data were not collected at any site because many were not easily accessible to an investigator without climbing assistance. Other sites were visited at infrequent intervals in order to reduce disturbance of other studies. Young fledged from 8 nests averaging 4.6 per brood. No mean clutch size was obtained.

DISCUSSION

Activity is strictly nocturnal and onset and end of daily activity remains the same in relation to sunset and sunrise even through the length of darkness becomes shorter as young are growing and requiring more food. Depsite this, I observed considerable time spent loafing, preening and calling, indicating that food was abundant and foraging efficient.

Almost all nests were located in natural rock cliffs or soil banks.

Differences in diets of individual pairs of owls can probably be explained by differences in availability of prey and to a lesser extent by individual prey preferences of owls.

Diets of barn owls in the BPSA are probably most similar to those of the long-eared owl (Asio otus) although little information is available on food habits of the other owls here. Comparison of barn owl prey from this study with a sample of 364 prey items of long-eared owls collected in the BPSA during 1979 (J. Marks, personal commun.) revealed a significant difference between the 2 species ($\chi^2 = 139.25$, $P < 0.005$). Prey species diversity of the long-eared owl diet was 2.43, nearly the same as for the barn owl. The 2 owls preyed on a similar array of species, however, and comparisons of samples taken from the same areas might show less difference.

The amount of interspecific competition for nest sites is not known. BLM records show that some sites have been occupied by barn owls, great horned owls (Bubo virginianus) and prairie falcons (Falco mexicanus) in different years. The abundance of nest sites and preference of barn owls to be near agricultural areas probably reduces competition for these cavities.

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Table 1. Barn owl prey from the Snake River Birds of Prey Natural Area, Idaho.

Prey Species	Number of Individuals	Percent Number	Percent Biomass[1/]
Mammals			
Antrozous pallidus	1	tr.	tr.[2/]
Sorex vagrans	32	0.4	tr.
Mus musculus	747	10.3	5.3
Peromyscus maniculatus	1,214	16.7	9.8
Reithrodontomys megalotis	296	4.1	0.1
Onychomys leucogaster	7	0.1	0.1
Neotoma cineria (adult)	10	0.1	1.3
Neotoma lepida (12 juv., 20 adult)	32	0.4	1.3
Ondatra zibethicus	1	tr.	0.4
Microtus montanus	3,224	44.4	41.1
Perognathus parvus	318	4.4	2.0
Dipodomys ordii	974	13.4	21.9
Thomomys spp. (213 juv., 47 adult)	260	3.6	12.2
Ammospermophilus leucurus	1	tr.	tr.
Spermophilus townsendi	2	tr.	0.1
Sylvilagus nuttali (very small juv.)	38	0.5	1.6
Birds			
Capella gallingao	2	tr.	tr.
Tyto alba (small juv.)	1	tr.	tr.
Sturnus vulgaris	12	0.2	0.4
Sturnella neglecta	4	tr.	0.2
Unidentified icterid	22	0.3	0.4
Unidentified medium bird	23	0.3	0.2
Unidentified small birds	43	0.6	1.0
TOTALS	7,264	100.0	100.0

1/ Estimated from weights in U.S.D.I. (1979).
2/ Less than 0.01%.

TITLE: Bioenergetics of nesting golden eagles.

INVESTIGATORS: Michael W. Collopy, Principal Investigator
Thomas Edwards, Research Technician
Kathy Collopy, Research Assistant

COOPERATOR: School of Natural Resources, University of Michigan, Ann Arbor, MI. 48105

OBJECTIVES:

1. To determine quantitatively, the food consumption and growth of nesting golden eagles.

2. To assess the relationship between the rate of food delivery, growthrates and survivorship of nestling eagles.

3. To assess parental investment of male and female adult eagles during the nesting season.

RESULTS

Field Studies

We observed the same nests in 1979 that were studied in 1978. Over 1600 hours were spent observing the sites during the incubation, brood-rearing, and post fledging periods. Nests were observed at a distance from a vehicle during the incubation and post-fledging periods. During the brood-rearing phase, observations at the nests were made from blinds, while activity of the adults away from the nest were made from a tracking vehicle. Observations at the nest site during brood-rearing were made every 6 days during a noon-to-noon sampling period. Data were collected on the daily activity of the young and adults on and away from each nest site. The number of food deliveries, identity of prey species, feeding bouts, and amount fed were recorded. Nests were entered at the end of each sampling period to collect prey remains and to weigh and examine the condition of the chicks.

Our collection of activity and habitat use data was facilitated by radio-telemetry. We followed one adult male eagle that was instrumented by Dr. Thomas Dunstan during Phase I, as well as two fledglings which we instrumented with tail mount transmitters.

Bioenergetic Feeding Trails

As in 1978 (Collopy 1978) we conducted bioenergetic feeding trails on two nestling golden eagles. Chicks were housed in mews that contained individual feeding compartments lined with plastic sheeting. Chicks were fed daily. Both chicks and food consumed were weighed daily. All excrement and castings were collected. Samples of food (jackrabbit), castings and excrement were

analyzed for caloric and ash content throuth bomb calorimetry analysis. Calculations of energy intake, energy output and metabolized energy were made for each study bird.

Project Status

Field work was completed in July and the Principal Investigator returned to the University of Michigan to begin analyzing data. A final report in the form of a dissertation will be completed in August 1980.

TITLE: Ecology of Townsend ground squirrels and demography of small mammals and birds in the Snake River Birds of Prey Study Area.

CONTRACTOR: Department of Biological Sciencies, University of Idaho, Moscow ID 83843

PERSONNEL: Donald R. Johnson, Principal Investigator
Graham W. Smith, Research Associate
Jay Breidenstein, Research Technician
Rhonda Helzner, Research Technician
Victoria Marks, Research Technician
Nicholas Nydegger, Research Technician
Dana Yensen, Research Technician

PROJECT SUPPORT: U. S. Department of the Interior, Bureau of Land Management, Contract No. 52500-CT5-1002.

OBJECTIVES:

1. Describe population variables of ground squirrel populations including productivity, recruitment, age and sex ratios, and turnover rates.

2. Ascertain yearly changes in prey species (cottontail rabbits, black-tailed jackrabbits, Townsend ground squirrels, ring-necked pheasants, passerine birds and reptiles) densities.

3. Stratify the Study Area into vegetation types and land use patterns. Check and correct where necessary the 1977-78 Birds of Prey Study Area vegetation map and sample the vegetation within each homogeneous vegetation stand.

4. Calculate the prey densities in terms of biomass within each vegetation type stratified in Objective 3.

ANNUAL SUMMARY

The vegetation was divided into 45 cover types. 21 of these types are duplicates to reflect the presence, abundance, or absence of Townsend ground squirrels (Spermophilus townsendi). We trapped 149 ground squirrels on 4 live trapping grids. Squirrel densities varied from 3.6 to 8.5 squirrels per hectare. All female squirrels captured had bred in 1979. Black-tailed jackrabbit (Lepus californicus) densities varied from 0.1 to 1.6 jackrabbits per hectare depending on vegetation type. Big sagebrush (Artemisia tridentata) and greasewood (Sarcobatus vermiculatus) had the highest jackrabbit densities. Mountain cottontail (Sylvilagus nuttalli) trapped in the canyon trapping sites averaged 1.2 rabbits per hectare in March and 1.6 rabbits per hectare in July while woodrats (Neotoma sp.) averaged 3.2 woodrats per hectare in March and 2.3 woodrats per hectare in July.

METHODS

Fire

Bureau of Land Management (BLM) fire records from 1959 through 1978 were examined, and all fires within the Birds of Prey Study Area (BPSA) over 100 acres were mapped.

Grazing

BLM grazing case history files from 1950 through 1978 were examined.

Vegetation

The vegetation stand boundaries on the 1978 vegetation map (USDI 1979a) were ground checked to verify that all vegetation within each stand was homogeneous. Lines were added or deleted as necessary. Only those lines within the proposed Conservation Area (as defined in USDI 1979b) were surveyed. Plant species canopy coverage and major shrub species density were estimated for each stand following the techniques described by Daubenmire (1959) and Asherin (1973). Habitat types, or cover types, were delineated by relating prey abundance to vegetation. First the vegetation was divided into the following major vegetation types:

Big sagebrush
Winterfat (*Cerratoides lanata*)
Big sagebrush - winterfat mosaics
Shadscale - (*Atriplex confertifolia*)
Shadscale - winterfat mosaics
Rabbitbrush (*Chrysothamnus* sp.)
Greasewood
Complex mixes of salt desert shrubs
Grasslands
Riparian areas

Vegetation types were then related to Townsend ground squirrel and black-tailed jackrabbit abundance. T-tests or analysis of variance were used to test if differences in ground squirrel or jackrabbit abundance could be accounted for by differences in plant species composition and density. Vegetation types were divided into the appropriate subtypes. These subtypes were called cover types.

Townsend ground squirrels

Townsend ground squirrels were live-trapped twice weekly from mid-February through late June at four live trapping sites. The Bedspring site was not trapped in 1979 because there were no squirrels living on the grid. Densities were estimated using the 'removal' population enumerator as computed by the 'Capture' program of Otis et al. (1978). The 'removal' enumerator is the most appropriate enumerator of the five enumerators

discussed by Otis et al. (1978) because it works well when capture probabilities vary by individual animal and by behavioral response to capture.

Vegetation was sampled at all of the trapping grids in the same manner as was done for the vegetation mapping portion of the project.

Eye lenses were collected, and embryo and placental scar counts were taken from female squirrels in order to compare litter size between adult and yearling age classes.

Black-tailed jackrabbits

As in previous years, the black-tailed jackrabbit flushing transects (USDI 1979a, Gross et al. 1974) were walked in March and November. In addition the average number of jackrabbits seen each day by a 2-person raptor survey crew was tabulated from field notes.

Ten spotlighting transects censusing the major vegetation types within the Study Area were run using the method of Flinders and Hansen (1973). Each transect was censused 3 times during mid-May to mid-June. The flushing distances for each vegetation type were plotted and the effective transect width was calculated as the distance at which the number of rabbits seen began to decrease. The number of rabbits per hectare were calculated for each covertype.

Cottontail rabbits and woodrats

Mountain cottontails and woodrats were censused using capture-recapture trap lines at the canyon riparian, canyon talus and canyon rim sites trapped in 1975 through 1978. Each trapline consisted of 20 traps. Densities were estimated using the 'removal' population enumerator (Otis et al. 1978). The effective trapping area was estimated from the trapping data by plotting the recaptures and using the maximum recapture distance as the diameter of a circular home range.

Pheasants

Estimates of ring-necked pheasant (Phasianus colchicus) densities were obtained from 9 crow-count transects (Kimball 1949). The transects censused pheasants in and near agricultural areas throughout the BPSA.

Passerines

Passerine birds were censused by walking 87 4-km transects (Emlen 1971) in April and early May. Transects were located within stands of homogeneous vegetation as identified on the 1978 Birds of Prey vegetation map. Bird densities were calculated using the method of Emlen (1971).

RESULTS

Fire

7.5 minute overlays for all maps of areas within the BPSA are on file at the BLM District Office. Literature on fire effects on vegetation and animals was gathered.

Grazing

The total number of animals and the dates the cows and sheep grazed federal range were coded. The data were keypunched and placed on the BLM's Honeywell computer. Literature on grazing effects on vegetation and on rodent, lagomorph, and passerine populations was gathered.

Vegetation

We identified 45 cover types (Table 1). Of these 21 are duplicates to reflect the presence, absence, or differences in Townsend ground squirrel densities. In addition, 4 canyon types (2 with ground squirrels and 2 without ground squirrels) were created to reflect cottontail rabbit presence. The average canopy coverage for each plant species within each cover type is given in Table 2.

Townsend ground squirrels

Vegetation. Plant coverage on the intensive study sites is given in Table 3.

Population Characteristics. We captured 149 ground squirrels on the intensive study sites in 1979 (Table 4). Squirrel numbers are still lower than they were in 1975 and 1976 prior to the drought of 1977. As in previous years the sex ratio of adults and yearlings favored females (1 to 1.42).

Estimated densities of ground squirrels on the live trapping grids (Table 5) varied from 3.6 to 8.5 squirrels per hectare. Densities are still lower than those of the predrought years of 1975 and 1976 when densities varied from 4.6 to 15.1 squirrels per hectare.

Survivorship of squirrels from 1978 to 1979 (Table 6) favored females. These results are very similar to those observed in previous years.

Reproduction. All adult male and female ground squirrels examined were in breeding condition in 1979. All yearling females collected were pregnant (n = 12), and all but one yearling male collected were in breeding condition (n = 14). The large number of yearlings in breeding condition in 1979 contrasts sharply with the breeding state of yearlings in 1975 and 1976. During those years approximately 60% of the yearling females bred, but only one case of a yearling male in breeding condition was noted. Squirrels did not breed in 1977 so there was no yearling cohort in 1978.

It is likely that the increase in numbers of yearlings breeding is a direct result of the decreased population caused by the drought of 1977.

Squirrels with heavier eye lenses (the adult age class) had significantly higher embroyo counts ($t = 3.41$, d.f. = 22, $P < 0.003$) than did females with lighter eye lenses (the yearling age class). This indicates that squirrels 2 or more years old have larger litters than do yearling aged squirrels.

Black-tailed jackrabbits

Spotlight transects. The big sagebrush and greasewood vegetation types had the densest jackrabbit populations (Table 7). Winterfat, shadscale and grass areas had very low numbers of jackrabbits.

Yearly trends. The average Gates index for the walking transects (Gross et al. 1974) in the spring was 14.2 and 43.5 for the fall. This latter figure is higher than that of 1978 (average = 17.4). The average number of rabbits seen per raptor study crew-day in 1979 was 2.6. This is also a large increase from the average of 1.2 rabbits seen in 1978. Both these increases indicate that the jackrabbit population has increased markedly and probably is approaching the height of the jackrabbit population cycle.

Cottontail rabbits

Cottontail rabbit densities ranged from 1.0 to 1.7 rabbits per hectare (Table 8). Only the canyon talus site had sufficient captures in the March and the July trapping periods to yield estimates for both seasons. This site had an 82% increase from spring to summer. The average effective trapping area for each site was 7.5 hectare.

Woodrats

Combined densities of bushy-tailed woodrat (Neotoma cinerea) and desert woodrat (Neotoma lepida) ranged from 0.9 to 3.7 woodrats per hectare (Table 9). The average effective trapping area for each site was 6.9 hectares.

Pheasants

April pheasant densities were 0.14 pheasants per hectare in old agriculture and 0.07 pheasants per hectare in new agriculture. The overall pheasant density for agriculture was 0.09 pheasants per hectare. 1979 densities were the highest densities calculated since censusing began in 1976.

Passerines

April-May passerine densities are given in Table 10. A series of t-tests indicated that there were no significant differences in the number of birds observed among the three field technicians who walked the transects.

Increased 1979 densities compared to 1978 are likely to be the result of increased sampling intensity (approximately twice as many miles walked in 1979 compared to 1978) rather than real increases in density.

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Table 1. Cover types within the proposed Birds of Prey National Conservation Area.

cover type number			
Townsend ground squirrel presence			
yes	low density	none	cover type name
1	40	23	low density big sagebrush
2	41	24	medium density big sagebrush
3	42	25	high density big sagebrush
4		26	big sagebrush-low density winterfat
5		27	big sagebrush-high density winterfat
6		28	winterfat-perennial grasses
7		29	winterfat-annual grasses
8		30	shadscale
9		31	shadscale-winterfat
10		32	big sagebrush-rabbitbrush
11		33	crested wheatgrass
12	45	34	grass
13		35	rabbitbrush
14		36	big sagebrush-shadscale
		15	greasewood-shadscale
		16	greasewood-big sagebrush
		17	greasewood
		18	Nutall saltbush
		19	riparian
20		37	canyon shrubs
21		38	canyon grass
22		39	cultivation
		43	unknown and misc.
		44	salt desert shrub mixes

Table 2. Average Canopy Coverage (%) for species within each covertype.

	Bud-sage	Big Sage-brush	4-Wing Salt-bush	Shad-scale	Nuttall Salt-bush	Spiny Hop-sage	Winter-fat	Rabbit-brush	Grease-wood	Little Leaf Horse-brush	Other Shrubs	Cheat-grass	Giant Rye-grass	Six Week Fescue
Low Density Big Sagebrush	0.60	8.47	0.17	0.0	0.32	1.70	0.0	0.0	0.0	0.13	0.26	10.66	0.04	0.42
Medium Density Big Sagebrush	0.08	13.33	0.13	0.0	0.28	0.27	0.0	0.0	0.0	0.04	0.01	3.02	0.0	2.47
High Density Big Sagebrush	0.0	18.91	0.0	0.0	0.0	0.08	0.0	0.0	0.0	0.0	0.0	2.74	0.0	2.72
Big Sagebrush-Low Density Winterfat	0.29	8.25	0.0	0.0	0.11	0.96	7.71	0.0	0.36	0.0	0.0	4.32	0.07	1.46
Big Sagebrush-High Density Winterfat	0.0	4.65	0.0	0.0	0.0	1.35	19.25	0.0	0.0	0.0	0.0	0.25	0.0	1.35
Crested Wheatgrass	0.0	0.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.44	0.06	0.12
Grass	0.02	0.11	0.0	0.0	0.0	0.0	0.0	0.12	0.0	0.0	0.0	9.12	0.44	0.87
Rabbitbrush	0.05	0.0	0.0	0.0	0.0	0.0	0.0	7.95	0.0	0.0	0.0	6.63	0.26	0.21
Greasewood-Shadscale	0.16	0.0	0.44	0.20	0.08	0.64	0.0	0.24	8.20	0.12	0.72	7.72	0.0	0.08
Greasewood	0.09	5.27	0.27	0.0	0.09	0.27	0.0	1.73	9.46	0.18	1.18	4.73	1.09	0.09
Winterfat-Perennial Grasses	0.00	0.0	0.0	0.0	0.0	2.62	23.50	0.0	0.0	0.0	0.0	3.25	0.0	1.50
Winterfat-Annual Grasses	3.47	0.0	0.0	0.0	1.05	0.05	23.05	0.0	0.0	0.0	0.0	0.68	0.0	2.21
Shadscale	4.06	0.0	0.21	7.06	0.43	0.70	0.06	0.21	0.0	0.36	0.0	2.77	0.0	0.0
Shadsclae-Winterfat	2.90	0.0	0.0	6.23	0.0	0.63	10.83	0.0	0.0	0.0	0.0	2.27	0.0	0.0
Big Sagebrush-Rabbitbrush	0.15	7.50	0.42	0.46	0.0	0.46	0.27	2.71	0.0	0.42	0.54	6.50	0.10	0.08
Big Sagebrush-Shadscale	2.24	1.82	0.12	2.65	0.0	1.41	0.0	0.29	6.00	0.41	0.06	4.65	0.0	0.18
Big Sagebrush-Greasewood	3.47	3.38	0.0	7.09	0.0	1.06	0.12	0.0	0.0	0.19	0.06	3.88	0.0	0.0

Table 2. Average Canopy Coverage (%) for species within each covertype (2nd half).

	Indian Rice-grass	Sand-berg Blue-grass	Bottle-brush Squirrel-tail	Tansy Mus-tard	Halo-geton	Russian Thistle	Tumble Mus-tard	Other Forbs	Other Grass	Crested Wheat-grass	Needle and Thread Grass	Desert Brome	Bare Ground
Low Density Big Sagebrush	0.09	2.57	1.28	0.38	0.04	1.09	0.93	1.80	0.14	0.36	0.24	0.0	73.92
Medium Density Big Sagebrush	0.02	2.86	1.92	0.29	0.0	0.22	0.77	3.06	0.15	0.0	0.04	0.0	77.86
High Density Big Sagebrush	0.0	3.38	2.24	0.28	0.0	0.06	0.24	1.43	0.36	0.0	0.15	0.0	71.45
Big Sagebrush-Low Density Winterfat	0.0	6.21	1.54	1.00	0.0	0.7	0.04	1.96	0.0	0.0	0.0	0.0	72.18
Big Sagebrush-High Density Winterfat	0.0	5.05	0.80	0.40	0.0	0.0	0.30	1.40	0.0	0.0	0.0	0.0	69.45
Crested Wheatgrass	0.0	3.56	0.62	0.0	0.12	1.88	1.44	1.44	1.44	11.44	0.0	0.0	72.12
Grass	0.23	2.25	0.66	0.77	0.04	3.10	2.72	4.07	0.04	0.07	0.47	0.0	68.42
Rabbitbrush	0.05	5.32	0.16	0.21	0.0	2.58	3.16	2.21	0.58	0.16	0.42	0.0	72.53
Greasewood-Shadscale	0.08	0.08	0.08	1.08	0.96	2.28	1.04	3.32	3.12	0.16	0.0	0.0	74.32
Greasewood	0.64	0.0	1.00	1.09	1.00	0.54	2.64	2.64	1.64	0.0	0.18	0.0	74.09
Winterfat-Perennial Grasses	0.0	12.38	1.12	0.88	0.0	0.0	0.0	4.62	0.0	0.0	0.0	0.0	57.00
Winterfat-Annual Grasses	0.0	1.47	1.42	0.63	0.0	0.05	0.05	2.10	0.0	0.0	0.0	0.0	68.63
Shadscale	0.04	0.74	0.77	0.34	0.13	0.49	0.28	1.21	0.0	0.0	0.0	0.0	81.81
Shadsclae-Winterfat	0.0	0.27	1.50	0.50	0.03	0.13	0.0	2.03	0.0	0.0	0.0	0.0	75.73
Big Sagebrush-Rabbitbrush	0.79	1.00	0.60	0.08	0.02	1.50	0.77	2.36	0.06	0.56	0.35	0.0	77.69
Big Sagebrush-Shadscale	0.12	1.00	1.06	0.0	0.71	0.47	0.18	1.00	0.12	0.12	0.0	0.0	79.71
Big Sagebrush-Greasewood	0.0	0.81	1.00	0.16	0.28	0.78	0.28	2.06	2.06	0.31	0.0	0.0	79.59

Table 2. Average Canopy Coverage (%) for species within each covertype.

Budsage	Artemisia spinescens
Four wing saltbush	Atriplex canescens
Nutall saltbush	Atriplex nuttalli
Spring hopsage	Atriplex spirosa
Little leaf horsebrush	Tetradymia glabrata
Cheatgrass	Bromus tectorum
Giant ryegrass	Elmus cinereus
Six week fescue	Festuca octoflora
Halogeten	Halogeten glomeratus
Russian thistle	Salsola kali
Tumble mustard	Sisymbrium altissimum

Table 3. Plant coverage (%) May 1979 on the Townsend ground squirrel intensive trapping sites.

Vegetation	Winterfat		Big Sage-brush	Winterfat-big sage	
	Healthy	Depleted		Burned	Unburned
Trapping Site	Winter-fat	Bed-Spring	Big Sage-brush	Burn	Comparison
Shrubs					
Big sagebrush			18.6		4.9
Nuttalls saltbush		0.4			
Spring Hopsage		0.1	0.9	0.1	6.1
Winterfat	37.4	0.2			22.0
Forbs					
Cruciferae	1.9	17.1	6.6	2.0	0.2
Russian thistle		2.7		5.3	
Other Forbs	1.2	0.4	0.6	0.2	1.4
Grasses					
Cheatgrass		5.5	6.4	7.3	
Six weeks fescue	4.4	0.1	1.9	0.1	0.3
Indian ricegrass				0.1	
Sandberg bluegrass	10.8	3.3	3.7	7.5	3.7
Bottlebrush squirreltail	0.1		0.3	1.6	0.1
Bare Ground	49.9	73.6	68.4	77.8	63.4

Table 4. Townsend ground squirrel captures in relation to age class on the intensive study sites 1979.

Site	Age Classes J	Y	A	U	TOTAL
Big Sage					
male	13	2	1	3	19
female	8	4	3	3	18
Winterfat					
male	11	6	0	2	19
female	11	6	0	3	20
Burn					
male	5	4	5	1	15
female	6	2	3	1	12
Comparison					
male	15	4	2	2	23
female	6	5	8	4	33
TOTAL					149
male	44		32		
female	31		42		

J = Juvenile, Y = Yearling, A = Adult, U = Unknown

Table 5. Estimated densities of Townsend ground squirrels using the removal estimator and an effective trapping area of 4.84 hectares for males and 2.56 hectares for females. 95% confidence intervals in parenthesis.

Site	Density Number/hectare	95% Confidence Interval
Big sage		
male	1.24	(1.03-1.45)
female	3.91	(3.52-4.30)
Winterfat		
male	1.65	(1.45-1.86)
female	3.52	(3.13-3.91)
Burn		
male	1.86	(1.65-2.07)
female	2.34	(1.95-2.73)
Comparison		
male	1.65	(1.45-1.86)
female	6.64	(6.25-7.03)

Table 6. Survivorship of Townsend ground squirrels from 1978 to 1979. Percent survival in parenthesis.

Site	Juvenile 1978	Yearling 1979	Yearling & Adults in 1978	Yearling & Adults in 1979
Big Sage				
male	11	1	5	0
female	4	1	12	0
Winterfat				
male	9	6	2	0
female	13	6	9	0
Burn				
male	9	4	10	2
female	4	2	13	3
Comparison				
male	16	4	13	1
female	15	5	15	6
Total				
male	45	15 (33%)	30	3 (10%)
female	36	14 (39%)	49	9 (18%)

Table 7. 1979 Black-tailed jackrabbit densities from spotlighting transects.

Vegetation Type	Density (Rabbits/ha)	Number of Rabbits Observed
Big sagebrush		
Low density	0.78	82
Medium density	0.81	136
High density	1.55	41
Winterfat	0.13	17
Shadscale	0.18	51
Shadscale-winterfat	0.09	24
Grass	0.04	10
Greasewood-shadscale	0.57	54
Greasewood	1.03	5
Big sagebrush-shadscale	0.21	5
Greasewood-big sagebrush	1.33	12

Table 8. Estimated densities of cottontail rabbits using the removal estimator and an effective trapping area of 7.5 hectares. 95% confidence intervals in parenthesis.

Site	Density (#/hectares) March	July
Canyon riparian	____a	1.54(1.23-1.85)
Canyon talus	0.95(.86-1.05)	1.73(1.6-1.87)
Canyon rim	1.48(1.11-1.85)	____a

a = Unable to calculate because insufficient animals captured.

Table 9. Estimated densities of woodrats using the removal estimator and an effective trapping arae of 6.9 hectares. 95% confidance intervals in parenthesis.

Site	Density (#/hectares) March	July
Canyon riparian	3.65(3.27-4.04)	2.72(2.47-2.96)
Canyon talus	a	0.93(0.8-1.07)
Canyon rim	2.69(1.28-4.10)	0.95(0.63-1.27)

a = Unable to calculate because insufficient animals captured.

Table 10. Passerine densities (individuals/km^2) for April-May derived from Emlen transects.

Cover Type	Horned Lark	Meadow Lark	Sparrow	Black-bird	Other Birds	Total
low density big sagebrush	1,500.0	305.6	527.8	27.8	277.8	2,638.9
medium density big sagebrush	4,533.3	833.3	2,000.0	50.0	800.0	8,266.7
high density big sagebrush	722.2	76.4	1,513.9	6.9	944.4	3,263.9
sagebrush-low density winterfat	300.0	133.3	354.2	4.2	800.0	1,591.7
sagebrush-high density winterfat	1.4	16.7	66.6	0.0	4.2	88.9
winterfat-perennial grasses	33.3	0.0	22.2	0.0	1.4	56.9
winterfat-annual grasses	33.3	0.0	11.1	0.0	22.2	66.7
shadscale	1,944.4	68.1	933.3	0.0	505.6	3,451.5
shadscale-winterfat	738.8	5.6	211.1	0.0	11.1	966.7
big sagebrush-rabbitbrush	133.3	38.9	266.7	11.1	1,011.1	1,461.7
crested wheatgrass	137.5	16.7	100.0	8.3	400.0	662.5
grass	4,033.3	687.5	1,711.1	488.9	1,054.2	7,975.0
rabbitbrush	722.2	111.1	333.3	0.0	76.4	1,243.1
big sagebrush-shadscale	355.6	5.6	72.2	0.0	22.2	455.7
greasewood-shadscale	166.7	72.2	177.7	0.0	533.3	950.0
greasewood-big sagebrush	0.0	11.1	11.1	0.0	44.4	66.7
greasewood	-a-	---	---	---		
Nutall saltbush	---	---	---	---		
riparian	---	---	---	---		
canyon shrubs	0.0	0.0	1.4	0.0	111.1	112.5
canyon grass	---	---	---	---		
cultivation	3,266.7	3,266.7	7,933.3	9,955.6	14,777.8	39,200.0

a not sampled

TITLE: Ecology of reptiles in the Snake River Birds of Prey Study Area.

CONTRACTOR: Department of Biological Sciences
University of Idaho, 83843.

INVESTIGATORS: Donald R. Johnson, Major Professor
Lowell Diller, Research Assistant
Ted Daehnke, Field Assistant

PROJECT SUPPORT: U.S. Department of the Interior, Bureau of Land Management, Contract No. 5200-CT5-1002

OBJECTIVES:

1. Determine the species composition and biomass of lizards and snakes in specific habitat types within the study areas.

2. Determine significant population parameters for these reptile populations including productivity, sex and age ratios, survivorship, and mortality factors.

3. Assess the availability of reptiles as prey for raptorial birds.

4. Determine the impact of snakes on prey populations utilized by raptorial birds.

5. Determine the effects of habitat alteration on reptile densities.

PROGRESS

The drift fence census of snakes that was done north of the Snake River in 1978 was continued in 1979 south of the river. Twelve drift fences were erected in eight different habitat/cover types, and were operated from 3 May until 23 July. A total of 129 snakes of six different species were captured.

In addition to the usual mark which is put on a snake when it is captured in a drift fence, 22 snakes of five different species were "tagged" with ^{182}Ta to monitor their movements. A 400 uCi tantalum wire was embedded beneath the skin of the tail, and the snakes movements were attempted to be monitored by picking up gamma rays using a Geier-Mueller counter. This was all done in isolated areas that had very little human activity.

The purpose of this work was to better estimate snake movements and activity, so that drift fence snake captures could be converted to density estimates. Seven snakes that were radioactively tagged were relocated at least once, and of these only three were successfully followed for any length of time. In spite of this general failure to relocate tagged snakes, the method did provide valuable information

in that it confirmed our earlier impression that snakes do not have a home range, but wander over relatively large areas in a somewhat random manner. This will allow us to develop a new model for converting drift fence captures into density estimates. The tagged snakes that escaped do not represent a health hazard in any way due to the short half-life of ^{182}Ta (about 100 days).

In addition to the above activities, considerable time was spent searching for snakes that were marked during previous field seasons, and collecting snakes for reproductive, fat body and food habits analysis. A total of 70 snakes were obtained in this manner, with 16 of them being recaptures.

From the fall of 1979 to the present, all of the data that have been collected in the last five field seasons have been analyzed and a final report is being written at the present time.

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